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GEOMETRIC AND CHRONOLOGIC EVOLUTION OF THE VERDE AND PAYSON BASINS OF CENTRAL ARIZONA AND POSSIBLE RELATIONSHIPS TO DETACHMENT FAULTING; D. S. Brumbaugh, Dept. of Geology, Box 6030, NAU, Flagstaff, AZ 86011

The Transition Zone of Arizona and the structural basins therein have been poorly understood features from a structural standpoint. This is true both of their overall geometry as well as their formation. Yet these basins have developed within the last 13 million years and thus represent perhaps the most recent phase of development related to the extensional tectonics of the Basin and Range province.

Recent work (Smith, 1984; Vance, 1983) as well as some older studies (Anderson and Creasy, 1958; Pedersen and Royce, 1970) provide data on the geometry of the Verde and Payson basins which can be used to constrain some hypotheses related to the development of these basins.

The work of Cloos (1968), Anderson et. al. (1983), Wernicke and Burchfiel (1982) and Davis et. al. (1980) suggest a spatial and chronologic relation exists between planar high angle normal faults and low angle detachment faults. Perhaps one of the clearest examples from the Basin and Range area appears to be from seismic reflection profiles of the Sevier Desert Basin area of Utah (Fig. 1). These profiles suggest the existence of a detachment surface which acts as a zone of structural accommodation for fault-controlled extensional basin development above it. Faults that appear either listric or planar intersect it from above. Note that the basins are asymmetric with the basin deepening in the direction of dip of the detachment surface.

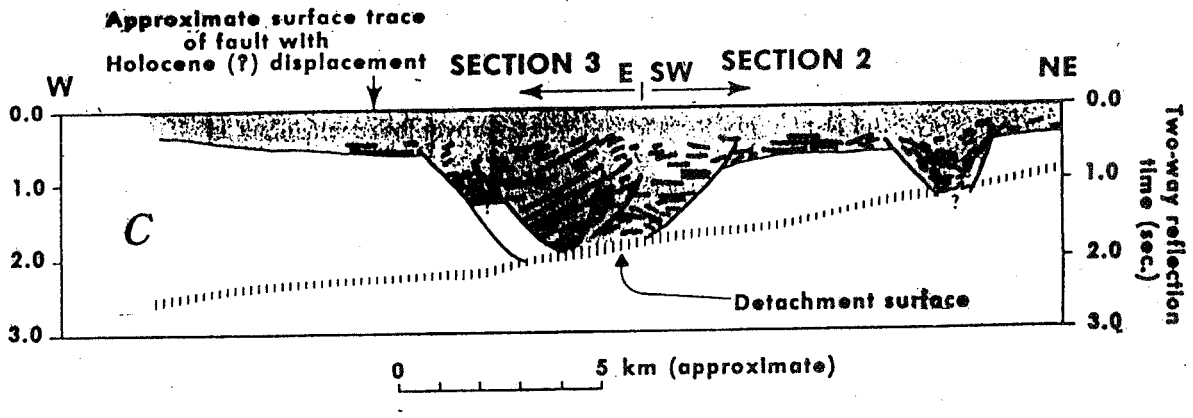

Figure 1. Seismic line across Sevier Desert Basin (Anderson et. al. Figure 7).

The question of interest then is whether or not the Verde and Payson basins might be related to a detachment fault at depth. This question can be discussed by taking the known geometry of the basins and comparing them to such a detachment fault model.

The Verde Valley is a structural basin which appears to be very similar to structures produced in Cloos' (1968) classic clay model experiments. One side of his basin was dominated by a master normal fault with displacement on the other side being accommodated by a number of smaller faults. The Verde Normal fault with over 2,000' of stratigraphic offset dominates the west boundary of the Verde Valley. It is a high angle planar normal fault. This is suggested by map trace, lack of rotation of the beds, and mining information.

The Payson basin, although less well known, appears quite similar with the west side of the basin bounded by a large fault. The Payson basin appears less mature with less offset on the master fault, and a thinner sequence of basin fill than the Verde Valley.

Radiometric (McKee and Anderson, 1971) and faunal (Nations et. al., 1982) data suggest that both basins began to develop at about the same time about 13 my ago. Chronologically this agrees well with the documented age of movement on the Rawhide detachment fault of SW Arizona 16-9 mya (Shackelford, 1980). If these basins are related to movement on the detachment fault there must be a spatial, as well as chronologic relation. The spatial question may be addressed by using as a starting point the Sevier Desert Basin model, and assuming that the planar high faults forming the Verde and Payson basins probably terminate against a projection of the Rawhide fault to the NE under these basins and further under the Colorado Plateau. This projection of the Rawhide Fault has been suggested (Shackelford, 1980) and would answer questions raised about the continuation of the Rawhide detachment fault.

The method used to analyze the question of possible spatial relation between the basin and detachment faults is one of projection based on the Sevier Desert Basin detachment fault. The planar high angle faults of the Verde basin are projected downward to locate an intersect point (Fig. 2). This is done for a number of profiles across the Verde Valley from Smith (1984). These intersect points represent the lowest possible points that would lie along the projected Rawhide detachment fault surface based on the Sevier Desert Basin model. The Rawhide detachment fault may be projected under the Verde basin by taking several reasonable average dips from the outcrop area and projecting to the northwest.

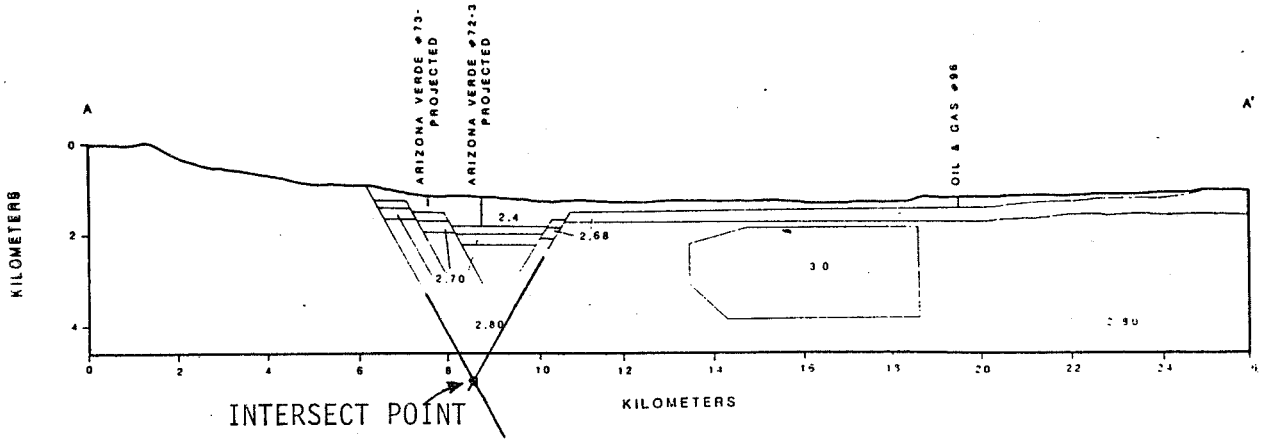

Figure 2. Verde Valley cross section A-A' (Smith, 1984, after Figure 5b)

The results of geometric projection suggest that the Rawhide fault does not appear to be a suitable candidate for a detachment fault for the Verde and Payson basins based on the Sevier Desert Basin model. This raises some interesting questions about the formation of these basins and detachment faults in general. Should other detachment fault-basin models be developed which would fit the Verde and Payson basins better? Do other detachment faults exist which have not been adequately recognized which would fit the spatial situation better? Or perhaps are the Verde and Payson Basins not related to detachment fault tectonics at all in their development?

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